Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

but surely the ego-centric predicament, when it occurs, does not prove that one knows only oneself.

In this partial, but incomplete, revision of absolute idealism lies the key to Professor Varisco's puzzle about the implication of the accidental. His theory of knowledge, resting at bottom upon the consistency theory, requires him to show the various elements of his philosophy as logically involved in one another. From this point of view, all that co-exists, and is, therefore, not contradictory, must be mutually implied. Every judgment must rest in a complete system of judgments which, developed fully, will wholly determine it. But the spontaneous and a-logical is just the one thing that can never find a place in such a system. The problem set by Professor Varisco's monadology is one for which there is no solution in the theory of knowledge which he retains. The spontaneities require that knowledge shall not develop from within merely, shall not be the becoming explicit of what is already implicit, but shall be genuinely additive. If the theory of knowledge stands, Professor Varisco's subconscious must take on all the essential qualities of the absolute. If the spontaneous and a-logical stand, he will have to look with more sympathy upon that "false and absurd metaphysics," pluralism.

GEORGE H. SABINE.

UNIVERSITY OF MISSOURI.

A RÉSUMÉ OF EXPERIMENTS ON THE PROBLEM OF LIGHTING IN ITS RELATION TO THE EYE

THE work of which this paper is a brief outline was done under the auspices of the American Medical Association. The object of the work has been to compare the effect of different lighting conditions on the eye and to find the factors in a lighting situation which cause the eye to lose in efficiency and to experience discomfort.

Confronting the problem of the effect of different lighting conditions on the eye, it is obvious that the first step towards systematic work is to obtain some means of estimating effect. The prominent effects of bad lighting systems are loss of efficiency, temporary and progressive, and eye discomfort. Three classes of effect, however, may be investigated: (1) the effect on the general level or scale of efficiency for the fresh eye; (2) loss of efficiency as the result of a period of work; and (3) the tendency to produce discomfort. A description of tests designed especially for the investigation of these effects has already appeared in print.[1] The test for the second effect, it may be mentioned, is not analytical in nature. Its results express an aggregate loss of function. Supplementary tests have been devised, therefore, by means of which the factors contributive to a given result may be separated out. A description of these tests is also included in the papers referred to above.

The following aspects of lighting sustain an important relation to the eye: the evenness of illumination, the diffuseness of light, the angle at which the light falls on the object viewed, the evenness of surface brightness, intensity, and quality. The first four of these factors, which may be grouped together as distribution factors, will be discussed briefly with reference to types of lighting now in common use.

The ideal condition with regard to the distribution factor is to have the field of vision uniformly illuminated with light well diffused and no extremes of surface brightness. When this condition is attained the illumination of the retina will shade off more or less gradually from center to periphery, which gradation is necessary for accurate and comfortable fixation and accommodation. In the proper illumination of a room by daylight, we have been able thus far to get the best conditions of distribution. Before it reaches our windows or skylights, daylight has been rendered widely diffuse by innumerable reflections; and the windows and skylights themselves acting as sources have a broad area and low intrinsic brilliancy, all of which features contribute towards giving the ideal conditions of distribution stated above. Of the systems of artificial lighting the best distribution effects, speaking in general terms, are given by the indirect systems, and the semi-indirect systems with a small direct component of light. In the indirect systems the source is concealed from the eye and the light is thrown against the ceiling or some other diffusely reflecting surface in such a way that it suffers one or more reflections before it reaches the eye. In some of the respects most important to the eye, this and the semi-indirect systems with a small direct component of light give the best approximation of the distribution effects characteristic of daylight of any that have yet been devised. The direct lighting systems are designed to send the light directly to the plane of work. There is in general in the use of these systems a tendency to concentrate the light on the working plane or object viewed rather than to diffuse it, and to emphasize brightness extremes rather than to level them down. Too often, too, the eye is not properly shielded from the light source and frequently no attempt at all is made to do this. The semi-indirect systems are intended to represent a compromise between the direct and indirect systems. A part of the light is transmitted directly to the plane of work through the translucent reflector placed beneath the source of light, and a part is reflected to the ceiling. Thus, depending upon the density of the reflector, this type of system may vary between the totally direct and the totally indirect as extremes and share in the relative merits and demerits of each in proportion to its place in the scale. By giving better distribution effects this type of system is supposed also to be a concession to the welfare of the eye, but our tests show that the concession, at least for the reflectors of low and medium densities, is not so great as it is supposed to be. In fact, installed at the intensity of illumination ordinarily used or at an intensity great enough for all kinds of work, little advantage seems to be gained for the eye in this type of lighting with reflectors of low or medium densities; for with these intensities of light and densities of reflector, the brightness of the source has not been sufficiently reduced to give much relief to the suffering eye. Until this is done in home, office, and public lighting, we can not hope to get rid of eye strain with its complex train of physical and mental disturbances.

---

[1] Ferree, C. E. "Tests for the Efficiency of the Eye under Different Systems of Illumination and a Preliminary Study of the Causes of Discomfort," *Trans. Ill. Eng. Soc.* 1913, *8*, pp. 40–60; "Untersuchungsmethoden für die Leistungsfähigkeit des Auges bei verschiedenen Beleuchtungssystemen, und eine vorläufige Untersuchung über die Ursachen unangenehmer optischer Empfindungen," *Z. f. Sinnesphysiol.*, 1915, *49*, pp. 59–78; "The Efficiency of the Eye under Different Systems of Lighting," *Fourth Intern. Congress on School Hygiene*, Buffalo, 1913, *5*, pp. 351–364; "Ophthalmology," July, 1914, pp. 1–16; "Mind and Body," 1913, *20*, pp. 280–286, 345–353; "The Problem of Lighting in Its Relation to the Efficiency of the Eye," *Science*, July 17, 1914, N. S., *15*, pp. 84–91; Ferree, C. E. and Rand, G. " The Efficiency of the Eye under Different Conditions of Lighting: The Effect of Varying Distribution and Intensity," *Trans. Illum. Eng. Soc.*, August, 1915, *10*, pp. 407–447; "Further Experiments on the Efficiency of the Eye under Conditions of Lighting," *Trans. Ill. Eng. Soc.*, August, 1915, *15*, pp. 448–504. See also J. R. Cravath. "Some Experiments with the Ferree Test for Eye Fatigue," *Trans. Ill. Eng. Soc.*, *1914*, *9*, pp. 1033–1047; also C. E. Ferree, "Discussion of Mr. Cravath's Paper, Some Experiments," etc., *ibid.*, pp. 1050–1059.

In the experimental work the following points are covered: the effect of varying the distribution factors on the ability of the eye to maintain its maximal efficiency for a period of work; the effect of varying the intensity of light with various groupings of distribution factors; and certain miscellaneous experiments relating to the hygienic employment of the eye. These latter experiments include the effect of varying the area and conversely the intrinsic brightness of the ceiling spots above the reflectors in an indirect system of lighting; the effect of varying the angle at which the light falls on the work in a given lighting situation; the effect of using an opaque eye-shade with light and dark linings with each of the lighting installations used in the distribution and intensity series; the effect on the efficiency of the fixation muscles of a period of work under each of these installations; the effect of motion pictures on the eye at different distances from the projection screen; and a determination of the tendency of all the conditions of lighting employed to produce discomfort and to cause loss of efficiency.

The investigations are not abstract in character. All the variations obtained were gotten in actual concrete lighting situations by employing lighting installations in common use. In order that a correlation might be made between lighting conditions and the effect on the eye, the following specification of illumination effects was made in each case. (1) A determination was made of the average illumination of the room under each of the installations of lighting used. The room was laid out in 3-ft. squares and illumination measurements were made at 66 of the intersections of these squares and at the point of work. Readings were taken in a plane 122 cm. above the floor with the receiving test-plate of the illuminometer in the horizontal, the 45 deg., and the 90 deg. positions, measuring respectively the vertical, the horizontal, and the 45 deg. components of illumination. The 122 cm. plane was chosen because that was the height of the test object. In the work on the distribution series the illumination was made as nearly as possible equal at the point of work. (2) A determination was made in candle-power per sq. in. of the brightness of prominent objects in the room, such as the test surface; the reflectors for the semi-indirect installation; the reflectors and filament for the direct installation, etc.; the reading-page; the specular reflection from surfaces; etc. The brightness measurements were made by means of a Sharp-Millar illuminometer with the test-plate removed. The instrument was calibrated against a magnesium oxide surface obtained by depositing the oxide from the burning metal. By this method the reflecting surfaces were used as detached test-plates. The readings were converted into candle-power per sq. in. by the following formula:

$$\text{Brightness} = \frac{\text{Foot-candles}}{\pi \times 144}$$

(3) Photographs were made of the room from three positions under each system of illumination.

The tests for the effect on the eye were made at four representative positions in the room. The observers used were all under 26 years of age. A clinic record was made of the eyes of each observer. The following results were obtained.

1. Of the lighting factors that influence the welfare of the eye,

those we have grouped under the heading of distribution are apparently fundamental. They seem to be the most important we have yet to deal with in our search for the conditions that give us the minimum loss of efficiency and the maximum comfort in seeing. If, for example, the light is well distributed in the field of vision, and diffuse, and there are no extremes of surface brightness, our tests indicate that the eye, so far as the problem of lighting is concerned, is practically independent of intensity. That is, when the proper distribution effects are obtained, intensities high enough to give the maximum discrimination of detail may be employed without causing appreciable damage or discomfort to the eye.

2. For the kind of distribution effects given by the direct and semi-indirect reflectors of low or medium densities, our results show that unquestionably too much light is being used in ordinary work for the comfort and welfare of the eye.

3. The angle at which the light falls on the object viewed is an important factor, but not nearly so important, for example, as evenness of surface brightness in the field of vision. Extremes of surface brightness in the field of vision seem to be the most important cause of the eye's discomfort and loss of efficiency in lighting systems as we have them at the present time. In lighting from exposed sources it is not infrequent to find the brightest surface from 1,000,000 to 2,500,000 times as brilliant as the darkest; and from 300,000 to 600,000 times as brilliant as the reading-page. These extremes of brightness in the field of vision are, our tests show, very damaging to the eye.

4. Of the systems of artificial lighting tested thus far, the best results have been obtained for the indirect system, and the semi-indirect systems with reflectors having a high density. By means of these reflectors the light is well distributed in the field of vision and extremes of surface brilliancy are kept within the limits which the eyes are prepared to stand. Considerable loss of efficiency has been found to result from the use of direct reflectors and semi-indirect reflectors of low or medium density.

5. The loss of efficiency sustained by the eye under an unfavorable lighting situation is found to be muscular, not retinal. The retina has been found to lose little if any more in efficiency under one than under another of the lighting systems employed.

6. Loss of efficiency of the fixation muscles is, according to our tests, a very small part of the eye's aggregate loss in muscular efficiency as the result of work under an unfavorable lighting system. The chief loss seems to be sustained by the accommodation muscles or the muscles which adjust the lens of the eye.

7. Eye-shades are apparently not an adequate substitute for

lamp-shades for the protection of the eye from the sources of light. The best results are obtained by means of an opaque eye-shade with a light lining. The usual opaque eye-shades with dark linings, while they shield the eye from the source of light, do not by any means eliminate harmful brightness differences in the field of vision. They in fact create for the eye a very unnatural brightness relation; *i. e.,* they make the whole upper half of the field of vision dark in sharp contrast with the brightly lighted lower half. The direct effect of this is a strong brightness contrast (physiological) over the lower half of the field of vision which causes glare in surfaces which have no glare and increases the glare in surfaces in which glare is already present. Moreover, the unusual and strongly irregular character of the image formed on the retina probably also sets up warfare in the incentives given to the muscles which adjust the eye. That is, the upper half of the field of vision is dark and presents no detail. The effect of this is probably to exert a tendency to cause the muscular relaxation characteristic of the darkened field of vision. The lower half of the field of vision is light and filled with detail. The incentive here is for the best possible adjustment of the eye for the discrimination of detail in the objects viewed, while the rim of the shade, the sharply marked boundary between the light and dark halves of the field of vision and much nearer to the eye than the objects viewed, serves as a constant and consciously annoying distraction to fixation and accommodation. These complex and somewhat contradictory impulses given to the muscles of the eye might very well and doubtless do cause an excessive and unnatural loss of energy and efficiency in case of the prolonged adjustment of the eye needed for a period of work. Translucent shades when made sufficiently opaque to give the necessary reduction to the image of the source, darken too much the upper half of the field of vision and simulate thereby too much the effect given by the opaque shade with the dark lining to give the best results for efficient and comfortable seeing.

8. The observation of motion pictures for two or more hours causes the eye to lose heavily in efficiency. The loss decreases rather regularly with the increase of distance from the projection screen. It seems little if any greater, however, than the loss caused by an equal period of working under much of the artificial lighting now in actual use. In making these tests care was taken to choose a projection apparatus which gave a picture comparatively steady and free from flicker.

9. In all the conditions tested a rather close correlation is found

to obtain between the tendency of a given lighting condition to cause loss of efficiency and to produce discomfort.

C. E. Ferree,
Gertrude Rand.

Bryn Mawr College.

REVIEWS AND ABSTRACTS OF LITERATURE

Les Origines de Connaissance: R. Turro. Paris: Felix Alcan. 1914. Pp. 269.

The present volume is the author's complete study of the origin of knowledge, portions of which appeared earlier. The main thesis which the author defends throughout the book is that knowledge, or the intellectual life, has an internal origin rather than an external origin, that it arises through some inner activity and not through the effect of external stimuli upon the sensorium. Thus he says[1] that "nothing is more incontestible than that external objects continuously act upon our organisms and our sensorial mechanism. But the intellectual life does not begin with this action; it begins at the very instant that one reacts upon the external sphere as the result of the trophic need with the resulting blind impulses to movement. Thereupon very complicated adaptations to this external sphere begin to develop and it is by virtue of these adaptations that we acquire the knowledge of reality, of causality, of space, etc." (p. 247). The explanation of this trophic need and the impulses to movement occupy the first 106 pages, the remaining 163 pages being given up to the discussion of the adaptations of the organism to external reality. According to Turro, the issue has been clouded by previous students who accepted instinct as a mysterious force by which the organism is capable of selecting from its environment those elements which shall satisfy the nutritive needs of the organism. Since the primordial fact for an organism is the experience which permits the entrance of food into his organism, the intellectual life begins with the functioning of this instinct in the presence of the appropriate external stimuli. This conception of instinct is due to the failure carefully to distinguish between what is innate and what is learned in an organism's behavior. From a number of experiments and observations the author concludes that the recognition of food is not due to an innate or instinctive consciousness, but is the result of learning. All that the organism has originally is an equipment of more or less coordinated movements which are closely associated with certain internal stimuli to be described later, but not with any external stimuli, such as the common notion of instinct implies. "One is not born with sight, hearing, taste, smell and touch; the most perfect sense begins by being very much like a microscope in the hands of a beginner who does not know how to control the light nor to adjust the instrument. . . . What one learns in this period is truly prodigious" (p. 216).

---

[1] Wherever quotations are used they indicate free translations of the author's ideas.